

### **Amendments to the Claims:**

*This listing of claims will replace all prior versions, and listings, of claims in the application:*

1. (previously presented) A method of controlling a hybrid electric vehicle powertrain having a power unit, an energy storage battery, and a controller responding to powertrain operating parameters including discharge power limit (DPL) and battery state of charge (SOC), the controller including a state machine having a plurality of states and an arbitrator for effecting a response to state machine change requests in accordance with the powertrain operating parameters, the method comprising a sequence of the following steps:

- (a) monitoring the powertrain operating parameters;
- (b) determining the values of the discharge power limit (DPL) and the state of charge (SOC) of the energy storage battery;
- (c) if the state machine is in an OFF state, which requests that the power unit be off, and the DPL is less than an ON level, causing the state machine to transition from the OFF state to an OPPORTUNISTIC state, which requests that the power unit be kept on if already on;
- (d) if the state machine is in an ON state, which requests that the power unit be on, and the DPL is greater than the ON level, causing the state machine to transition from the ON state to the OPPORTUNISTIC state;
- (e) if the state machine is in the OPPORTUNISTIC state and the DPL is less than a MIN level, the MIN level being less than the ON level, causing the state machine to transition from the OPPORTUNISTIC state to the ON state; and
- (f) if the state machine is in the OPPORTUNISTIC state and the DPL is greater than an OFF level, the OFF level being greater than the ON level, causing the state machine to transition from the OPPORTUNISTIC state to the OFF state.

2. (canceled)

3. (canceled)

4. (previously presented) A method of controlling a hybrid electric vehicle powertrain having a power unit, an energy storage battery, and a controller responding to powertrain operating parameters including discharge power limit (DPL) and battery state of charge (SOC), the controller including a state machine having a plurality of states and an arbitrator for effecting a response to state machine change requests in accordance with the powertrain operating parameters, the method comprising a sequence of the following steps:

- (a) monitoring the powertrain operating parameters;
- (b) determining the values of the discharge power limit (DPL) and the state of charge (SOC) of the energy storage battery;
- (c) if the state machine is in an OFF state, which requests that the power unit be off, and the SOC is less than an ON level, causing the state machine to transition from the OFF state to an OPPORTUNISTIC state, which requests that the power unit be kept on if already on;
- (d) if the state machine is in an ON state, which requests that said power unit be on, and the SOC is greater than the ON level, causing the state machine to transition from the ON state to the OPPORTUNISTIC state;
- (e) if the state machine is in the OPPORTUNISTIC state and the SOC is less than a MIN level, the MIN level being less than the ON level, causing the state machine to transition from the OPPORTUNISTIC state to the ON state; and
- (f) if the state machine is in the OPPORTUNISTIC state and the SOC is greater than an OFF level, the OFF level being greater than the ON level, causing the state machine to transition from the OPPORTUNISTIC state to the OFF state.

5. (previously presented) A method of controlling a hybrid electric vehicle powertrain having a power unit, an energy storage battery, and a controller responding to powertrain operating parameters including discharge power limit (DPL) and battery state of charge (SOC), the controller including a state machine having a plurality of states and an arbitrator for effecting a response to state machine change requests in accordance with the powertrain operating parameters, the method comprising a sequence of the following steps:

- (a) monitoring the powertrain operating parameters;
- (b) determining the values of the discharge power limit (DPL) and the state of charge (SOC) of the energy storage battery;
- (c) if the state machine is in an OFF state, which requests that the power unit be off, and the DPL or SOC is less than an ON level, causing the state machine to transition from the OFF state to an OPPORTUNISTIC state, which requests that the power unit be kept on if already on;
- (d) if the state machine is in an ON state, which requests that said power unit be on, and the DPL or SOC is greater than the ON level, causing the state machine to transition from the ON state to the OPPORTUNISTIC state;
- (e) if the state machine is in the OPPORTUNISTIC state and the DPL or SOC is less than a MIN level, the MIN level being less than the ON level, causing the state machine to transition from the OPPORTUNISTIC state to the ON state; and
- (f) if the state machine is in the OPPORTUNISTIC state and the DPL or SOC is greater than an OFF level, the OFF level being greater than the ON level, causing the state machine to transition from the OPPORTUNISTIC state to the OFF state.

6. (currently amended) A method of controlling a hybrid electric vehicle powertrain having a power unit, an energy storage battery, and a controller responding to powertrain operating parameters including discharge power limit (DPL) and battery state of charge (SOC), the controller including a state machine having a plurality of states and an arbitrator for effecting a response to state machine change requests in accordance with the powertrain operating parameters, the method comprising a sequence of the following steps:

- (a) monitoring the powertrain operating parameters;
- (b) determining the values of the discharge power limit (DPL) and the state of charge (SOC) of the energy storage battery;
- (c) if the state machine is in an OFF state, which requests that the power unit be off, and the DPL is less than an ON level, causing the state machine to transition from the OFF state to an OPPORTUNISTIC state, which requests that the power unit be kept on if already on;

(d) if the state machine is in an ON state, which requests that the power unit be on, and the DPL is greater than the ON level, causing the state machine to transition from the ON state to the OPPORTUNISTIC state;

(e) if the state machine is in the OPPORTUNISTIC state and the DPL is less than a MIN level, the MIN level being less than the ON level, causing the state machine to transition from the OPPORTUNISTIC state to the ON state; and

(f) if the state machine is in the OPPORTUNISTIC state and the DPL is greater than an OFF level, the OFF level being greater than the ON level, causing the state machine to transition from the OPPORTUNISTIC state to the OFF state;

~~The method of Claim 1~~ wherein the step of monitoring the powertrain operating ~~variables~~ parameters includes monitoring the drive mode of the powertrain to determine whether it is in reverse drive or forward drive, the ON level and the OFF level being dependent on the drive mode of a vehicle transmission.

7. (previously presented) A method of controlling a hybrid electric vehicle having a power unit, an energy storage battery, a transmission, and a controller including a state machine having a plurality of states including an ON state, which requests that said power unit be on, an OFF state, which requests that said power unit be off, and an OPPORTUNISTIC state, which requests that said power unit be kept on if already on, the method comprising a sequence of the following steps:

(a) determining the values of a discharge power limit (DPL) and a state of charge (SOC) of the energy storage battery;

(b) if the state machine is in the ON state and the DPL or SOC is greater than an ON level, causing said machine to transition from the ON state to the OPPORTUNISTIC state;

(c) if the state machine is in said OFF state and the DPL or SOC is less than an ON level, causing the state machine to transition from the OFF state to the OPPORTUNISTIC state;

(d) if the state machine is in the OPPORTUNISTIC state and the DPL or SOC is less than a MIN level, wherein the MIN level is less than the ON level, causing the state machine to transition from the OPPORTUNISTIC state to the ON state; and

(e) if said machine is in the OPPORTUNISTIC state and the DPL or SOC is greater than an OFF level, wherein the OFF level is greater than the ON level, causing the state machine to transition from the OPPORTUNISTIC state to the OFF state.

8. (withdrawn) A controller for a hybrid electric vehicle having a power unit and an energy storage device, said controller comprising:

a state machine having a plurality of states including an ON state, which requests that said power unit be on, an OFF state, which requests that said power unit be off, and an OPPORTUNISTIC state, which requests that said power unit be kept on if already on;

means for determining the value of a parameter of said storage device;  
means for requesting a transition of said machine from said OFF state to said OPPORTUNISTIC state if said parameter drops below an ON level;

means for requesting a transition of said machine from said ON state to said OPPORTUNISTIC state if said parameter rises above said ON level;

means for requesting a transition of said machine from said OPPORTUNISTIC state to said ON state if said parameter drops below a MIN level, which is less than said ON level; and

means for requesting a transition of said machine from said OPPORTUNISTIC state to said OFF state if said parameter rises above an OFF level, which is greater than said ON level.

9. (withdrawn) The controller of Claim 8 wherein said vehicle includes a transmission and the MIN level, ON level, and OFF level are one set of values when the transmission is in a drive position and another and respectively higher set of values when the transmission is in a reverse position.

10. (canceled) A method of controlling the starting and stopping of a power unit of in a hybrid electric vehicle having an energy storage battery, and a controller including an arbitrator for commanding the power unit to start or stop based on an evaluation of requests to the arbitrator, the method comprising a sequence of the following steps:

(a) determining the value of a discharge power limited (DPL) and a state of charge (SOC) of the energy storage battery;

(b) if the power unit is off and the level of the DPL or SOC is greater than an ON level, issuing an arbitrator request to turn the power unit off;

(c) if the power unit is off and the level of the DPL or SOC drops below the ON level, issuing an arbitrator request that the engine be kept on if the power unit is presently on; and

(d) if the level of the DPL or SOC is less than a MIN level, issuing an arbitrator request that the power unit be turned on until the level of the DPL or SOC achieves the ON level, and thereafter issuing a request that the power unit be kept on if the power unit is presently on.

11. (withdrawn) The controller defined in Claim 9 wherein said ON level has a value that is between said MIN level and said OFF level.

12. (canceled) The method of Claim 10 wherein the vehicle includes a transmission and the controller stores first and second sets of MIN, ON, and OFF levels, the first set being for use when the transmission is in a forward drive mode and the second set for use when the transmission is in a reverse drive mode.

13. (canceled) The method of Claim 12 wherein the values of the second set are higher than the respective values of the first set.

14. (canceled.)

15. (canceled.)

16. (canceled) A method of controlling a hybrid electric vehicle having a power unit, an energy storage battery and a controller including a state machine having a plurality of states, the method comprising a sequence of the following steps:

(a) determining the value of a discharge power limit DPL and a state of charge (SOC) of the storage battery;

(b) if the state machine is in an ON state, which requests that the power unit be on, and the DPL or SOC is greater than an ON level, causing the state machine to transition from the ON state to an OPPORTUNISTIC state; and

(c) if the state machine is in the OPPORTUNISTIC state and the DPL or SOC is less than a MIN level, the MIN level being less than the ON level, causing the state machine to transition from the OPPORTUNISTIC state to the ON state.

17. (canceled) A method of controlling a hybrid electric vehicle having a power unit, an energy storage battery, and a controller including a state machine having a plurality of states, the method comprising a sequence of the following steps:

(a) determining the value of a discharge power limit (DPL) and a state of charge (SOC) of the storage battery;

(b) if the state machine is in an OFF state, which requests that the power unit be off, and the is less than an ON level, causing the state machine to transition from the OFF state to an OPPORTUNISTIC state, which requests that the power unit be kept on if already on; and

(c) if the state machine is in the OPPORTUNISTIC state and the DPL or SOC is greater than an OFF level, the OFF level being greater than the ON level, causing the state machine to transition from the OPPORTUNISTIC state to the OFF state.

18. (withdrawn) A controller for a hybrid electric vehicle having a power unit and an energy storage device, the controller comprising:

a state machine having a plurality of states including an ON state, which requests that the power unit be on, an OFF state, which requests that the power unit be off, and an OPPORTUNISTIC state, which requests that the power unit be kept on if already on;

means for determining the value of a parameter of the storage device;

means for requesting a transition of the machine from the OFF state to the OPPORTUNISTIC state if the parameter drops below an ON level; and

means for requesting a transition of the machine from the ON state to the OPPORTUNISTIC state if the parameter rises above the ON level.

19. (withdrawn) A controller for a hybrid electric vehicle having a power unit and an energy storage device, the controller comprising:

a state machine having a plurality of states including an ON state, which requests that the power unit be ON, an OFF state, which requests that the power unit be OFF, and an OPPORTUNISTIC state, which requests that the power unit be kept on if already on;

means for determining the value of a parameter of the storage device;

means for requesting a transition of the machine from the OPPORTUNISTIC state to the ON state if the parameter drops below a MIN level, which is less than the ON level; and

means for requesting a transition of the machine from the OPPORTUNISTIC state to the OFF state if the parameter rises above an OFF level, which is greater than the ON level.